The aquatic and marshland plants of Bundi District, Rajasthan[1]

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The paper gives a detailed account of the aquatic and marshland flora of Bundi district in south-eastern part of Rajasthan. The district has remained botanically unexplored from lack of facilities. The region, apparently unsuitable for the growth of luxuriant vegetation, maintains a rich aquatic and wetland flora. The present study shows that 97 species of vascular plants belonging to 42 families inhabit the lakes, ponds, puddles and marshes in the district.

Introduction

The flora of Rajasthan has been studied in great detail since the publication of Blatter & Hallberg's (1918-21), ' The Flora of the Indian Desert '. In recent years, studies have also been undertaken on the hydrophytic and wetland flora of the terrain (Ratnam & Joshi 1952 ; Sarup 1958, 1961 ; Nair & Kanodia 1959 ; Vyas 1962 ; Gupta 1966 ; *see* also Biswas & Calder 1937 ; Subramanyam 1962). There is, however, a lacuna in our knowledge of the flora of Bundi district in south-eastern part of Rajasthan. The present paper deals with a detailed floristic survey of the aquatic and marshland plants of the district. The region was surveyed in different seasons during the years 1968 and 1969. Specimens of aquatic and marshland species collected during this study are preserved in the Herbarium of Floristic Botany Division, National Botanic Gardens, Lucknow.

Location and Habitats

Bundi district is situated in the south-eastern part of Rajasthan between 24°59′ and 25°59′ N., and 75°18′ and 76°21′ E. It is bounded on the north by Tonk district, on the east by Kota district and on the west

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by Bhilwara district. In the south, it is delimited by Kota and Bhilwara districts. The district occupies an area of 3473 sq. km and is situated at an altitude of 302 m above m.s.l.

The present study was conducted over a greater part of the district, with special reference to the following areas :

1. *Bundi :* The town of Bundi is situated in a narrow and picturesque sandstone gorge. It forms part of the south-eastern plateau of Rajasthan where the Aravallis meet the Vindhyas. The northern part is covered with Aravalli rocks and in the south are the Vindhyas and sedimentary rocks consisting of sandstone and limestone. The soil is deep black and fertile. The area has been provided with a canal system hewn out of the rocks. The hydrophytes and marsh plants are found in places like Bara Talao, Talao Gaon, Shikarburj and in the vicinity of Mangli and Ghodapachad rivers. Besides, there are extensive low-lying areas including paddy fields which support a thick growth of these plants. The artificial lakes like Phool Sagar, Nawal Sagar and Jaith Sagar have only sparse vegetation.
2. *Hindoli :* Hindoli is a small tehsil of Bundi district and is situated at a distance of about 20 km to the north of Bundi on Bundi-Ajmer Road. Besides several ponds and ditches which dry up during the winter and summer months, it includes a large perennial lake occupying an area of about 2 sq. km. This lake supports rich aquatic and marsh vegetation throughout the year. The Mej river flows at a distance of about 8 km in the south-west of the town and is another habitat for the growth of hygrophilous vegetation.
3. *Talera :* Talera is situated at a distance of about 15 km in the western part of Bundi on Kota-Bundi Road. The River Talera and a number of ponds and puddles are the habitat for the hydrophytic vegetation.
4. *Indragarh :* Indragarh is situated at a distance of about 70 km in the north-eastern part of Bundi. It is a low-lying area which gets flooded during the rainy season. In the following months, it is richly covered by a luxuriant vegetation of aquatic and wetland species.
5. *Kishorapatan :* It is situated in the immediate vicinity of Kota district. A number of tanks, ponds and paddy fields support thick growth of aquatic and marsh vegetation.

Soil and Climate

The climate of the area is dry monsoonic and shows three well marked seasons, namely rainy, winter and summer seasons. During the months of May and June, the mean maximum temperature of 42·3°C has been recorded. The mean minimum temperature of 6·6°C has been recorded in the months of December and January. Out of the total annual rainfall, the months of July to October receive 750-900 mm of rains which is 99% of the total fall of the year. The rains are infrequent during the winter season. The soil can be broadly classified into clay and clay-loam types. The clay content varies from 25-48%, and shows 25-50% silt and 25-50% sand. The dispersion co-efficient has been found to be very low, thus indicating a good water stable structure and a resistance to detachability by flood water.

Plant Associations

The aquatic and marsh vegetation of the district shows a number of associations in different localities and situations. Besides, there are pure communities of *Eichhornia crassipes* (Mart.) Solms, *Nelumbo nucifera* Gaertn., *Pistia stratiotes* Linn., *Potamogeton pectinatus* Linn., *P. perfoliatus* Linn., *Trapa bispinosa* Roxb., and *Typha angustata* Bory & Chaub. in different parts of the district. The present investigation shows that associations of following plants are noticeable in the area :—

1. *Aquatic habitat :* Associations—
   - A. *Zannichellia — Hydrilla — Ceratophyllum — Nymphoides — Utricularia* (Hindoli) ;
   - B. *Azolla — Spirodela* (Kota-Bundi Road) ;
   - C. *Nymphaea — Nymphoides — Zannichellia* (Bundi) ;
   - D. *Potamogeton — Hydrilla — Ceratophyllum* (Talera) ;
   - E. *Nymphaea — Hydrilla* (Talab Gaon).

2. *Marshy and wetland habitats :* Associations—
   - A. *Typha — Crinum — Phragmites — Sarcostemma — Scirpus* (Talera) ;
   - B. *Bacopa — Marsilea — Cyperus* (Kota-Bundi Road) ;
   - C. *Phyla — Marsilea — Eclipta* (Kota-Bundi Road) ;
   - D. *Hygrophila — Eclipta — Alternanthera — Bacopa* (Talera) ;
   - E. *Eriocaulon — Cyperus — Fimbristylis* (Bundi-Hindoli Road) ;
   - F. *Juncellus — Polygonum* (Kota-Bundi Road) ;
   - G. *Monochoria — Marsilea* (Bundi-Indragarh Road) ;
   - H. *Ammannia — Caesulia — Aeschynomene* (Indragarh).

TABLE 1

SHOWING THE HABITAT, FLOWERING PERIOD AND DETAILED DISTRIBUTION OF HYDROPHYTES AND MARSHLAND SPECIES

Species	Habitat	Flowering period	Localities				
			1	2	3	4	5
1. MARSILEACEAE							
Marsilea minuta Linn.	B	Aug.-Oct.	+	+	+	+	+
2. SALVINIACEAE							
Azolla pinnata R. Br.	A		+	+	—	+	+
3. EQUISETACEAE							
Equisetum ramosissimum Desf. subsp. *ramosissimum*	F		—	—	+	—	—
4. NYMPHAEACEAE							
Nelumbo nucifera Gaertn.	B	March-July	—	+	—	—	—
Nymphaea nouchali Burm. f.	B	July-Oct.	+	+	+	—	—
N. stellata Willd.	B	July-Oct.	+	+	—	—	+
5. CRUCIFERAE							
Coronopus didymus (Linn.) Sm.	F	Jan.-March	+	—	—	+	+
6. ELATINACEAE							
Bergia ammanioides Roxb.	F	Oct.-Dec.	—	+	—	—	—
7. STERCULIACEAE							
Melochia corchorifolia Linn.	F	Sept.-Nov.	—	+	—	+	+
8. TILIACEAE							
Corchorus capsularis Linn.	F	July-Sept.	+	+	—	+	+
C. trilocularis Linn.	F	July-Oct.	—	+	—	—	+
9. PAPILIONACEAE							
Aeschynomene indica Linn.	E, F	July-Oct.	+	+	—	—	+
Sesbania bispinosa (Jacq.) W. F. Wight	F, E	Aug.-Oct.	+	+	—	+	+
10. CAESALPINIACEAE							
Cassia tora Linn.	F	July-Sept.	+	+	—	+	+
11. ROSACEAE							
Potentilla supina Linn.	F	Jan.-April	+	+	+	+	+
12. LYTHRACEAE							
Ammannia baccifera Linn.	F	July-Oct.	+	+	+	+	+
A. multiflora Roxb.	F	Aug.-Nov.	+	—	—	—	—
13. ONAGRACEAE							
Ludwigia adscendens (Linn.) Hara syn. *Jussiaea repens* Linn.	A	Aug.-Nov.	+	+	—	+	+
L. octovalvis (Jacq.) Raven subsp. *sessiliflora* (Mich.) Raven syn. *Jussiaea suffruticosa* Linn.	F	Oct.-Jan.	+	+	+	—	+
L. perennis Linn. syn. *L. parviflora* Roxb.	E, F	Aug.-Nov.	+	+	—	+	+

Explanation of symbols :

+ = present ; — = absent ; A = Free-floating ; B = Attached with floating leaves and/or shoots ; C = Suspended submerged ; D = Attached submerged ; E = Aquatic or Amphibious emerged ; F = Wetland ; 1 = Bundi ; 2 = Hindoli ; 3 = Talera ; 4 = Indragarh ; 5 = Kishorapatan.

TABLE 1 (*Contd.*)

	Species	Habitat	Flowering period	Localities				
				1	2	3	4	5
14.	TRAPACEAE							
	Trapa bispinosa Roxb.	A	Sept.-Dec.	+	+	+	+	+
15.	MOLLUGINACEAE							
	Glinus lotoides Linn.	F	Oct.-Dec.	+	+	—	+	+
16.	RUBIACEAE							
	Dentella repens (Linn.) Forst.	F	Jan.-March	+	+	—	—	+
17.	COMPOSITAE							
	Caesulia axillaris Roxb.	E, F	Sept.-Dec.	+	+	+	+	+
	Eclipta prostrata (Linn.) Linn.	F	Most part of the year	+	+	+	+	+
	Sphaeranthus indicus Linn.	F	Oct.-Feb.	+	+	—	+	+
	Gnaphalium indicum Linn.	F	Dec.-March	+	+	+	—	+
	Centipeda minima (Linn.) A. Br. & Aschers. syn. *C. orbicularis* Lour.	D, F	Oct.-Feb.	—	+	+	+	—
18.	GENTIANACEAE							
	Enicostemma hyssopifolium (Willd.) Verdoorn syn. *E. littorale* Bl.	F	July-Nov.	+	—	+	—	+
	Hoppea dichotoma Willd.	F	Oct.-Nov.	—	—	+	+	+
19.	LIMNANTHACEAE							
	Nymphoides cristatum (Roxb.) Ktze.	B	Jan.-March	—	+	+	—	+
	N. indicum (Linn.) Ktze.	B	Jan.-March	—	+	+	—	—
20.	ASCLEPIADACEAE							
	Sarcostemma esculentum (Linn. f.) Holm syn. *Oxystelma esculentum* (Linn. f.) Schult.	F	March-May	—	—	+	—	—
21.	BORAGINACEAE							
	Heliotropium ovalifolium Forsk.	F	March-May	—	+	—	—	+
22.	CONVOLVULACEAE							
	Ipomoea aquatica Forsk.	A	Dec.-March	+	+	+	+	+
23.	SCROPHULARIACEAE							
	Bacopa monniera (Linn.) Pennell	E	Sept.-Dec.	+	+	+	+	+
	Limnophila indica (Linn.) Druce	E	Feb.-Apr.	—	—	+	—	—
	Lindernia crustacea Muell.	F	Jan.-Mar. & July-Sept.	+	+	+	+	+
	L. procumbens (Krock.) Philcox syn. *Vandellia pyxidaria* Maxim.	F	Jan.-Mar.	+	—	+	—	—
	Veronica anagallis-aquatica Linn.	E, F	Jan.-Mar.	+	+	+	+	+
	Verbascum chinense (Linn.) Sant.	F	Jan.-March	+	+	+	—	+
24.	LENTIBULARIACEAE							
	Utricularia aurea Lour.	A	Aug.-Jan.	—	+	+	+	—
	U. gibba Linn. subsp. *exoleta* (R. Br.) Tayl. syn. *U. exoleta* R .Br.	A	Jan.-Apr.	+	+	—	—	—

TABLE 1 (*Contd.*)

Species	Habitat	Flowering period	Localities				
			1	2	3	4	5
25. ACANTHACEAE							
Hygrophila auriculata (Schumach.) Heine syn. *Asteracantha longifolia* Nees	F	Jan.-Mar.	+	+	+	+	+
Hemiadelphis polyspermus Nees syn. *Hygrophila polysperma* T. Anders.	F	Sept.-Mar.	+	+	+	—	+
Justicia quinqueangularis Koen. ex Roxb.	F	Aug.-Nov.	+	+	+	+	+
26. VERBENACEAE							
Phyla nodiflora (Linn.) Greene	F	Throughout the year	+	+	+	+	+
27. AMARANTHACEAE							
Alternanthera sessilis (Linn.) DC.	F, E	Most part of the year	+	+	+	+	+
A. paronychioides St. Hil.	F	Sept.-Jan.	+	+	—	—	—
Amaranthus tenuifolius Willd.	F	Oct.-Dec.	—	+	—	—	—
28. POLYGONACEAE							
Polygonum barbatum Linn. subsp. *gracile* Danser	E	Aug.-Dec.	+	—	+	—	+
P. glabrum Willd.	E	Aug.-Nov.	+	+	+	+	+
P. plebejum R. Br.	F	Aug.-Nov. & Mar.-June	+	+	+	+	+
Rumex dentatus Linn.	F	Feb.-Apr.	+	+	+	—	—
29. CERATOPHYLLACEAE							
Ceratophyllum demersum Linn.	C	Jul.-Sept.	+	+	+	+	+
30. HYDROCHARITACEAE							
Hydrilla verticillata (Linn. f.) Royle	C	Jul.-Sept.	+	+	+	+	+
Ottelia alismoides (Linn.) Pers.	D	Jan.-Mar.	—	+	+	—	—
Vallisneria spiralis Linn.	D	Feb.-Apr.	+	+	+	—	—
31. AMARYLLIDACEAE							
Crinum defixum Ker-Gawl.	E, F	Most part of the year	+	+	+	+	+
32. PONTEDERIACEAE							
Eichhornia crassipes (Mart.) Solms	A	May-Oct.	+	+	+	+	+
Monochoria vaginalis (Burm. f.) Presl	E, F	Aug.-Oct.	+	+	—	+	+
33. PALMAE							
Phoenix sylvestris (Linn.) Roxb.	F	Mar.-May	+	+	+	—	+
34. TYPHACEAE							
Typha angustata Bory & Chaub.	E	Jul.-Nov.	+	+	+	+	+
35. ARACEAE							
Pistia stratiotes Linn.	A	Apr.-Jun.	—	+	—	—	—
36. LEMNACEAE							
Spirodela polyrrhiza Schleid.	A	Oct.-Jan.	+	+	+	+	+

TABLE 1 (*Contd.*)

Species	Habitat	Flowering period	Localities				
			1	2	3	4	5
37. POTAMOGETONACEAE							
Potamogeton crispus Linn.	D	Feb.–May	+	+	+	+	+
P. pectinatus Linn.	C	Jan.-Mar.	—	—	+	—	—
P. perfoliatus Linn.	D	Feb.-May	—	—	+	—	—
38. ZANNICHELLIACEAE							
Zannichellia palustris Linn.	C	Feb.-Mar.	+	+	+	+	+
39. NAJADACEAE							
Najas marina L. syn. *N. major* All.	C	Sept.-Dec.	—	—	+	—	—
40. ERIOCAULACEAE							
Eriocaulon quinquangulare Linn.	F	Dec.-Apr.	+	+	—	+	+
41. CYPERACEAE							
Eleocharis atropurpurea Kunth	F	Jan.-May	—	+	+	+	—
Fimbristylis bisumbellata (Forst.) Bub. syn. *F. dichotoma* Cl.	F	Aug.-Nov.	+	+	+	+	+
F. aestivalis Vahl	F	Sept.-Dec.	+	—	—	+	—
Cyperus alopecuroides Rottb.	F, E	Aug.-Dec.	+	—	+	—	+
C. compressus Linn.	F	Aug.-Dec.	+	+	+	+	+
C. digitatus Roxb.	E	Jul.-Sept.	+	+	—	—	+
C. difformis Linn.	E	Sept.-Dec.	+	+	+	+	+
C. eleusinoides Kunth	E	Sept.-Nov. & Jan.-Feb.	—	+	+	—	—
C. flavidus Retz.	F	Dec.-Mar.	+	—	—	+	—
C. iria Linn.	F	Aug.-Nov.	+	+	+	+	+
C. pygmaeus Rottb.	F	Jul.-Oct.	+	+	+	+	+
C. pangorei Rottb. syn. *C. tegetum* Roxb.	F	Dec.-Apr.	—	—	+	—	+
C. rotundus Linn.	F	Jul.-Dec.	+	+	+	+	+
Scirpus articulatus Linn.	F	Jan.-May	—	+	—	—	—
S. roylei (Nees) Parker	F	Jul.-Nov.	+	—	—	+	—
S. supinus Linn.	F	Oct.-Dec.	+	+	—	+	+
S. tuberosus Desf.	F, E	Dec.-Mar.	—	—	+	+	—
42. GRAMINEAE							
Arundo donax Linn.	F	Oct.-Dec.	—	—	—	+	—
Coix lachryma-jobi Linn.	E, F	Sept.-Dec.	—	+	+	—	—
Echinochloa colonum (Linn.) Link	F	Jan.-Oct.	+	+	—	+	+
Hygroryza aristata Nees	A	Apr.-June	+	+	—	—	—
Isachne miliacea Roth	E	Nov.-Feb.	—	—	—	+	—
Oryza sativa Linn.	F, E	Oct.-Nov.	+	+	+	+	+
Paspalidium punctatum Stapf	E, F	Sept.-Nov.	+	+	+	—	+
Phragmites maxima Blatt. & McC.	F	Sept.-Jan.	—	+	—	—	—
Vetiveria zizanioides Nash	F	Aug.-Oct.	—	—	—	+	+

Discussion

The area, apparently unsuitable for the growth of luxuriant vegetation, is rich in aquatic and marshland species. The Chambal river passes through the hilly terrain and supports aquatic and marsh vegetation in the ravines. Its tributaries like Talera, Mej and Mangli carry a considerable amount of sand and are favourable spots for the ecesis of hydrophytes. The Hindoli Talao, Talera river and Bara Talao in Bundi are among the important habitats for the growth of aquatic and marsh vegetation.

The present study shows that 97 species of vascular plants inhabit the riverain and wetland areas of the district (Table 1). Of these, 34 species occur in aquatic situations, 51 in marshes and wetlands and the rest, both in aquatic and wetland situations. This paucity of aquatic species may be due to rocky bottom and wide amplitude of water level in puddles and reservoirs. Some species are restricted to a single habitat, e.g. *Equisetum ramosissimum* Desf. subsp. *ramosissimum*, *Nelumbo nucifera* Gaertn., *Bergia ammanioides* Roxb., *Amaranthus tenuifolius* Willd., *Ammannia multiflora* Linn., *Sarcostemma esculentum* (Linn. f.) Holm, *Limnophila indica* Druce, *Potamogeton pectinatus* Linn., *P. perfoliatus* Linn., *Scirpus articulatus* Linn., *Arundo donax* Linn., *Isachne miliacea* Roth, *Phragmites maxima* Blatt. & McC., and *Najas marina* L. Among the species occurring throughout the area may be mentioned *Marsilea minuta* Linn., *Ammannia baccifera* Linn., *Potentilla supina* Linn., *Trapa bispinosa* Roxb., *Caesulia axillaris* Roxb., *Eclipta prostrata* Linn., *Ipomoea aquatica* Forsk., *Bacopa monniera* Pennell, *Lindernia crustacea* Muell., *Veronica anagallis-aquatica* Linn., *Hygrophila auriculata* Heine, *Justicia quinqueangularis* Koen. ex Roxb., *Phyla nodiflora* Greene, *Alternanthera sessilis* DC., *Polygonum glabrum* Willd., *P. plebejum* R. Br., *Ceratophyllum demersum* Linn., *Hydrilla verticillata* Royle, *Crinum defixum* Ker-Gawl., *Eichhornia crassipes* Solms, *Typha angustata* Bory & Chaub., *Spirodela polyrrhiza* Schleid., *Potamogeton crispus* Linn., *Zannichellia palustris* Linn., *Fimbristylis bisumbellata* Bub., *Cyperus difformis* Linn., *C. iria* Linn., *C. pygmaeus* Rottb. and *C. rotundus* Linn.

The following species are rather uncommon in the flora of Rajasthan and have been collected during the course of this study : *Ludwigia perennis* Linn., *Utricularia gibba* Linn. subsp. *exoleta* Tayl., *Ottelia alismoides* (Linn.) Pers., *Cyperus flavidus* Retz., *Cyperus pangorei* Rottb., *Cyperus alopecuroides* Rottb., *Monochoria vaginalis* Presl, *Eleocharis atropurpurea* Kunth, *Amaranthus tenuifolius* Willd. and *Najas marina* L.

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